

TERMITE PROTECTION

With Copper Shields



A HANDBOOK

FRANKLIN INSTITUTE
PHILADELPHIA

TERMITE PROTECTION

With Copper Shields



Reg. U. S. Pat. Off.

A HANDBOOK FOR
ARCHITECTS AND
SHEET METAL
WORKERS—ON THE
APPLICATION OF
SHEET COPPER FOR
TERMITE PROTECTION

Issued by

COPPER & BRASS RESEARCH ASSOCIATION

420 LEXINGTON AVENUE

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TERMITES

MAN'S FIGHT AGAINST INSECTS

From the days of the Cave Man on down through the flight of centuries there has been waged on this planet a strange war. It is a conflict between Man and Insects. Recently the Smithsonian Institute in Washington broadcast a most interesting description of this warfare over a coast-to-coast hookup. The man before the microphone dramatically recounted many of these fights won by the insects.

The retreat of Napoleon from Moscow more than a century and a quarter ago is still considered the greatest military tragedy in all the history of the world. There are few persons perhaps who know it was insects rather than artillery and bullets that mowed down the flower of the army of that great military leader.

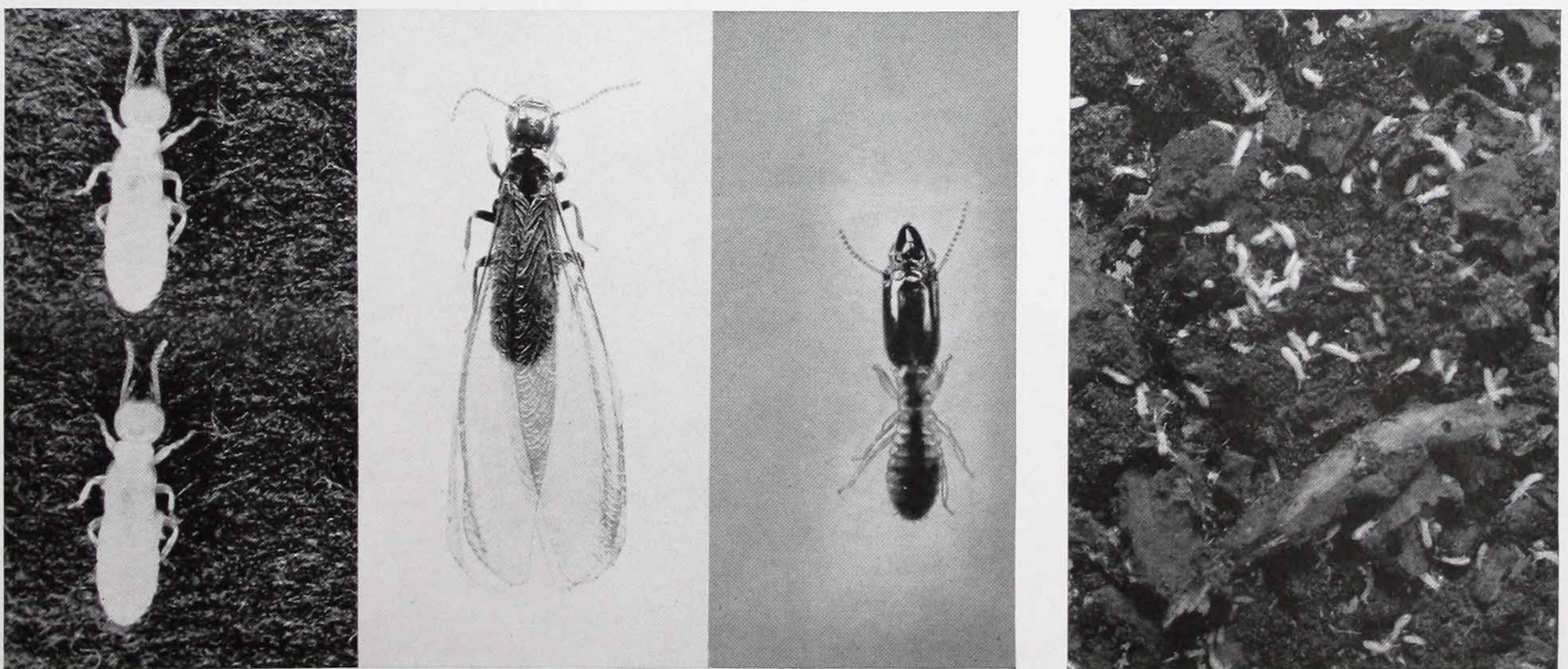
At the head of 600,000 well equipped fighting men baptised in the blood of many battles, Napoleon marched on Russia. As the great French Army entered Russia they were stricken by a strange illness that caused the sudden death of thousands just as had the "Black Plague" struck horror to London where men, women and children died by the thousands.

The medical staff found that an army of insects was annihilating this great fighting machine. They were typhus-bearing bugs. When Napoleon finally retreated, after stubbornly opposing for weeks the advice of his Field Marshals, he returned to France with less than 100,000 men, more than a half million having died largely from the infection of these disease-carrying bugs.

Today in these United States there is an insect that is not destroying human life but is causing a loss to property owners of approximately \$50,000,000 annually. This insect is the Termite, and the damage has become so great in recent years that the United States Government, through the Department of Agriculture, as well as many State Agricultural Departments—is conducting extensive research in an effort to stamp them out just as they devised means of combatting the Japanese beetle and other coleopterous insects. The Government and many state bureaus of entomology are studying their habits and how best to eradicate them. Many states are considering the enactment of legislation making it compulsory to protect buildings against these pests.

Termites are closely related to the cockroach family but they are constructed much differently. The cockroach has an armor, while the termite has not and therefore can flatten out and squeeze through a narrow opening that would only permit water to seep through. It has been reported that these insects have penetrated minute cracks in concrete. For that reason it is necessary to have buildings protected so that they cannot build their tunnels from the ground and enter them.

The termite is a prolific little insect. Some authorities contend that a Queen is capable of laying many thousands of eggs a day. Her average life is from five to fifteen years, with the result that it would require some-



The illustrations above show three of the castes of subterranean termites enlarged about five to six times. *At left* are two workers; *in center* a winged reproductive; *at right* a soldier. The workers are greyish-white, but the reproductive type much darker in color. Note that termites do not have the "wasp waist" characteristic of ants.

A "posed" photograph of a group of termites, mostly workers, scurrying to get under cover again after being exposed to have their picture taken. They shun light.

ID 89-38323 TCF

thing of a mathematician with the aid of adding machines to determine her life's total egg laying ability. The egg laying ability of the Queen is a striking illustration of how fast these insects breed and why they have spread in every section of the country.

Working under cover and in the dark, these insects not only destroy some \$50,000,000 worth of property annually, but they also leave many buildings unsafe for use. In addition to feeding on wood they eat cellulose, rugs, clothing, books and paper. They get into unprotected buildings by means of subterranean tunnels which they construct over foundation posts and pipes. The results of their attacks are seldom discovered until

considerable damage has been done to beams, joists and flooring, as they shun the light.

Contained in the pocket on the back cover of this booklet are four blueprint drawings showing approved methods of using Copper shields. We believe they will be of interest and considerable assistance to architects and sheet metal contractors in using these shields both for new construction and in buildings that were not protected and which the termite has entered and is gradually destroying. Once the contact with the ground is cut off the termites already in a building will soon die. That is why Copper shields protect both old and new construction from attack.

TYPES & DISTRIBUTION

Within recent years, damage by termites has been found in nearly every state. Contrary to general popular belief, this is not due to a recent introduction of these pests. They are widely distributed throughout the entire world and many fossil remains have been found. Termites flourished on this earth long before man. They belong to the general biological family of *Isoptera*. In all, close to 2,000 different species have been classified. In the United States however, the **SUBTERRANEAN TERMITES** of the various species classified as *Reticulitermes* are responsible for 95% of the damage done. It is with this type and the methods of controlling their activities that this pamphlet deals.

In a long, narrow seaboard strip from North Carolina south along the Atlantic and Gulf coasts, and across the southern boundary of the United States and along

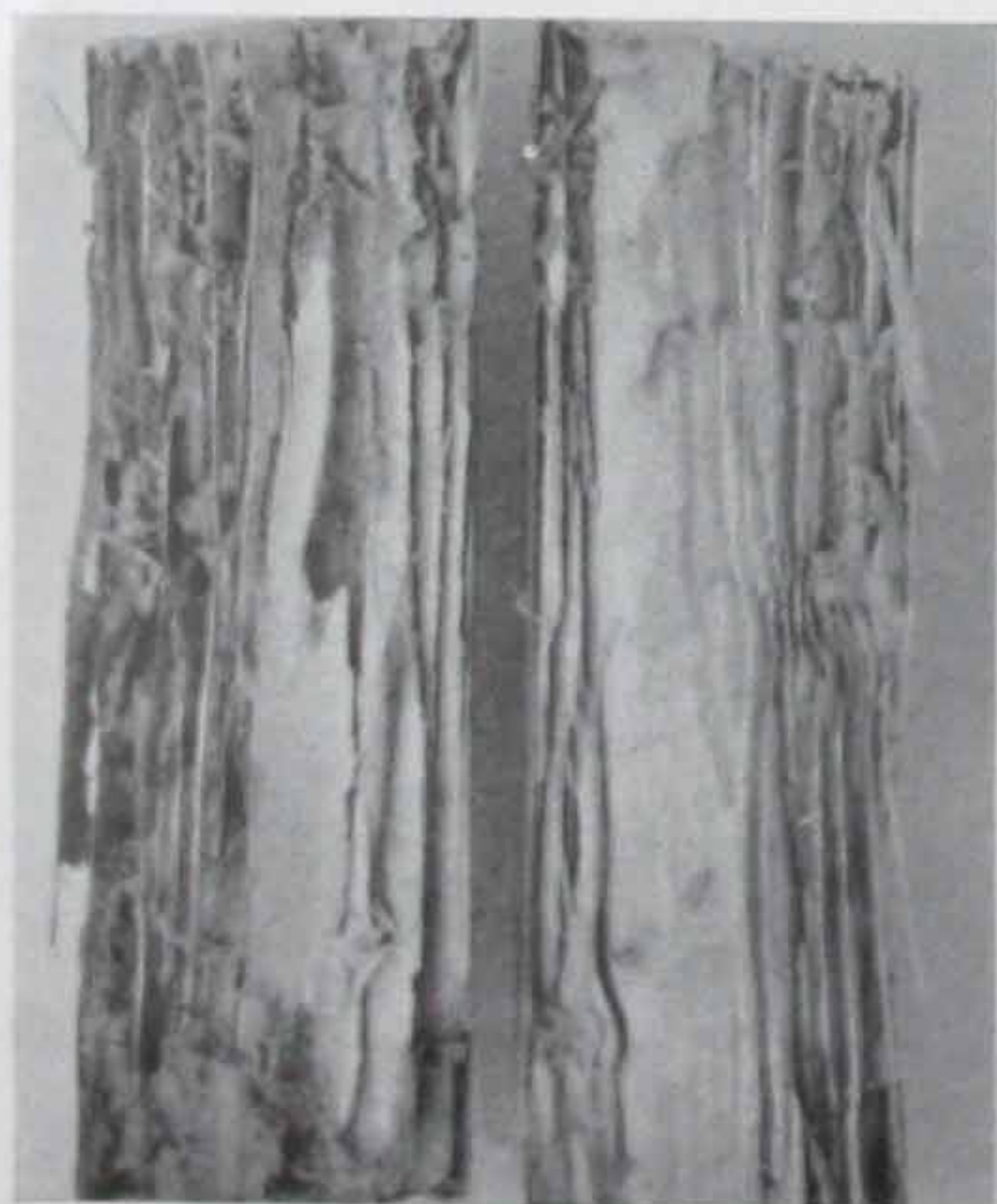
the coast of California, there also occurs another classification of these insects, the **DRY WOOD TERMITES**, *Calo termes*. Control measures against this type must take other forms and are not dealt with in this pamphlet.

Certain tropical forms of termites found in Central and South America, and in Africa, build large nests on the ground or in trees. Some of these species reach a size of about 4 inches in length. However, our North American subterranean termite rarely attains a length over a quarter of an inch and except for the shelter tubes which they sometimes build over inedible material, and the appearance of the winged forms at times of swarming, seldom give any indication of their presence until they cause failure of some structural timber by having eaten out the inside. They work silently and unseen.

BIOLOGY OF THE TERMITE

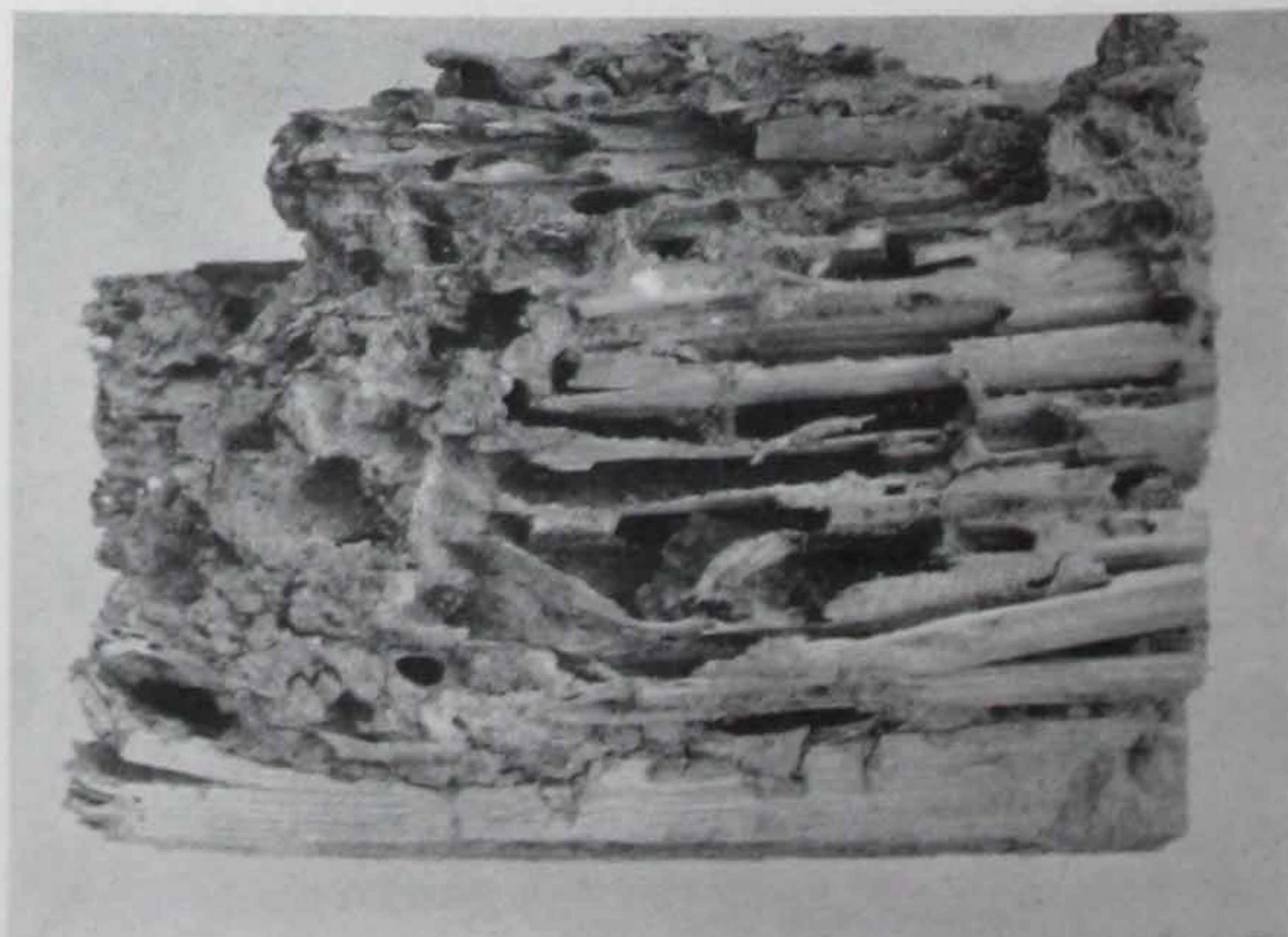
SUBTERRANEAN TERMITES are an important group of social insects, living in colonies, whose members are divided into a number of castes. These different forms all develop from eggs and young that look alike, at

least externally. The adults of each caste have certain definite functions to perform and are distinctive in appearance. While termites are commonly called "white ants," they are not ants, nor are all forms white. The



Left: Photograph of wood showing typical termite damage. Termites eat their way around annual rings in the wood, leaving paper-thin sections between which they live silent and unseen.

Right: Another piece of wood showing typical termite damage done by the worker caste. They are careful to stay within the wood, leaving no sign of their presence on the outside.



termite is a distinct order of insect, closely related to the cockroach, and ants are among their most deadly enemies in the insect world.

Among the termite castes, the workers are blind, greyish-white, wingless and sexless, and they live entirely under cover. This caste is responsible for all the damage to wood or other cellulose products which termites eat. These workers make all the excavations in the ground or wood, feed all the other castes and construct the covered runways or tubes of earthlike material by which they cross objects that they cannot penetrate. In heavy infestation these tubes are frequently built down from wood to obtain additional soil contacts for moisture.

The soldiers are about the same size and color as the workers and are also blind and sexless. They have enlarged heads with strongly developed jaws and their sole function is to protect the colony from enemies, such as rival termites and ants. The soldiers also have a protuberance on their foreheads, from which they can squirt a sticky fluid that they use in "chemical warfare" against their enemies.

The queen has a black head and thorax, and the abdomen is enlarged and partly white. She will usually be found near the center of the colony, in the nest in the ground. With her will be found one or two true males. In some colonies will also be found, at least two forms of secondary reproductive females. They are important in causing a rapid increase in colony size.

In the Spring (and sometimes again in the Fall) large numbers of dark brown winged males and females

may appear in the colony. The time of their swarming varies in different latitudes and seems also, in some way not yet clearly understood, to depend on local atmospheric conditions.

The swarming winged males and females, in about equal numbers of each sex, emerge from the ground or infested wood from holes closed up afterwards by workers. They usually fly only a short distance (unless carried by the wind) and, on alighting, seek to again enter the ground to establish a new colony. They lose their wings after the brief flight and resume their underground and out-of-sight mode of living. They must reestablish contact with ground moisture or they cannot live. Often large numbers of discarded wings are the only evidence to be found that a swarming has taken place, and that a termite colony is nearby.

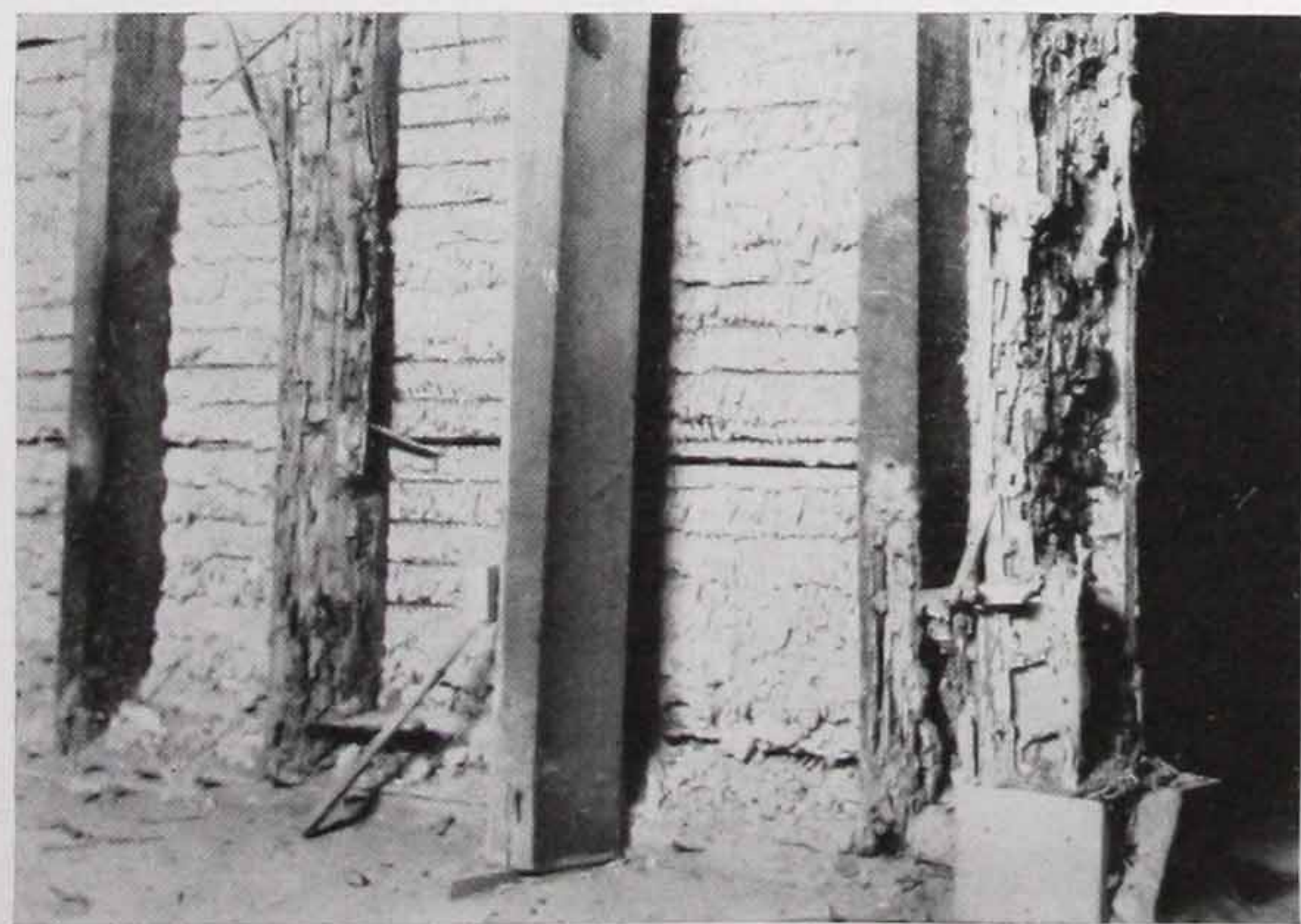
This dependence on ground moisture is the reason that shielding, properly installed, is so effective in protecting a house against termite damage. They cannot live in the wood itself. Wood forms only their food supply. They must have moisture or they will dry out and die. That is why termites already in a house will die if shielding is installed to break their contact with the earth. Termites that might be isolated above the shield will try to build tubes down to the ground. Careful inspection and destruction of these tubes will soon kill any termites in a house. Thus properly installed shielding is a protection not only against entrance from the ground, where the nest and the center of colony life is, but stops contact of termites above it with ground moisture, thereby destroying them.

WHY TERMITES ATTACK BUILDINGS

As noted previously, termites are no new development of insect life. They are more prominent now than formerly for a number of reasons. Their natural habitat was in the woods and, active only in warm months, they attracted little attention. But our woods and forests have been cut down and their natural source of food supply has diminished. At the same time houses have been built over extended areas and these furnished a

new and most conveniently located source of food supply.

Moreover, many houses of recent construction have been ideal for termite attack, with wood in direct contact with the ground. Then, too, heated houses and warm cellars have enabled termites to extend their activities of eating and breeding throughout the whole year, not just during the summer months. Hence their greater apparent numbers and activity.



Left: Termite damage to posts in cellar partition wall. Note shoring-up of wall while damage can be repaired and copper shielding installed so as to prevent future termite attack.



Right: Not only wood but other cellulose products are eaten by termites. Here is an example of how valuable records are sometimes attacked and destroyed by these pests.

COPPER TERMITE SHIELDS

BASIC SHIELD DESIGN

Types and Functions

SUBTERRANEAN TERMITES must have moisture to live. That is the basis for the efficacy of shielding for termite control. The primary function of the shield is to prevent the termites from entering the building to destroy wood which acts as their food supply. The shield also serves to break the contact between termites already in a building and the ground moisture necessary for their continued existence. Copper, with its ease of forming, and its rustproof and corrosion resistant qualities, is the accepted material for shields that will give lasting protection.

In the pocket in the back of this booklet will be found blueprint sketches **T-1** to **T-11** inclusive which show the basic design of copper termite shields and

also their application to various construction details.

Termite shields may be of either one or two forms as shown in **Figures T-1** and **T-2**, or a compromise between the two types. Where the shield, after installation, is not readily open to inspection, a Barrier type of shield is required. This is so constructed that the termites building up over the stone or concrete foundation cannot pass beyond the shield into the woodwork of the house above. The standard designs of shields shown in **Figure T-1** are dimensioned to conform to standard stock widths of copper sheet. Cold rolled copper is used to give the projection of the shield the proper stiffness. Twenty ounce copper is recommended although 16 oz. can often be used satisfactorily.

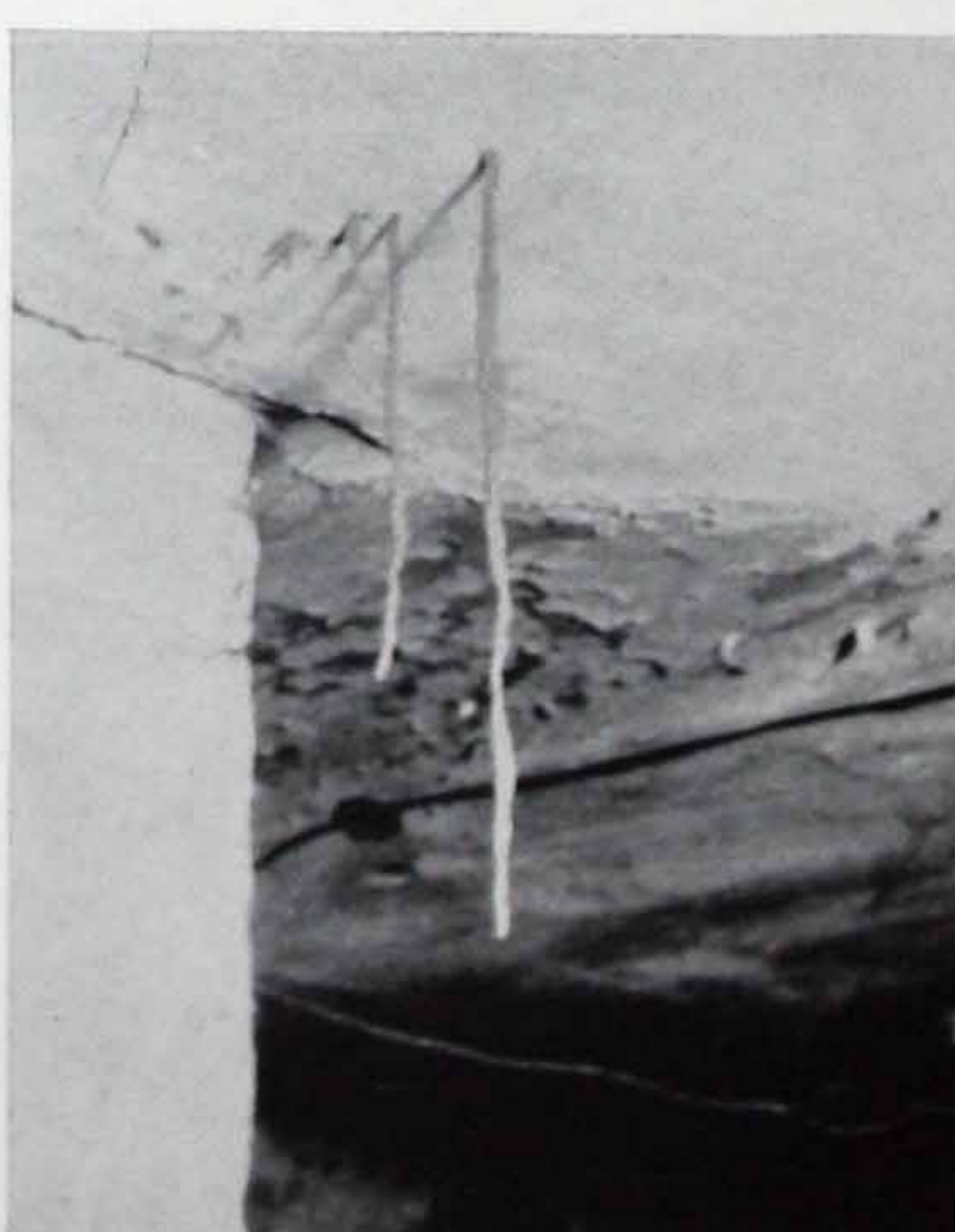
Barrier Type Shields

The two basic types of Barrier shields are illustrated in **A** and **B** of **Figure T-1**. The vertical turn-down edge of the type shown in **A** is preferable, but type **B** is also satisfactory and under certain conditions easier to use.

The copper shield provides a lasting and impenetrable metal barrier. The sharp edge of the metal, either vertical or at 45°, provides a 180° angle around which the termites are unable to construct a shelter tube. There are designs of shield offered in which the edge is rolled for stiffness, but such construction is not recom-

mended as shelter tubes might be built around this roll, whereas there is no record of their being built over a sharp edge of the metal as shown in **A** and **B**.

At corners, as in standard types of through-wall flashing, it is better to use a specially formed piece as in **C** than to have a diagonal seam across the corner. Four types of cross seams are shown at **D, E, F** and **G**. Types **D** and **E** should be tightly malletted. When the soldered types (**F** or **G**) are used, the ends of the sheets should be pre-tinned to ensure a solid joint.



The left view shows a shelter tube built by termites under artificial conditions. The right view shows a shelter tube built by termites over a wall to gain access to the wood in the sill above. The hole in the sill was made to inspect the extent of the termite damage.

Shelter tubes built down from above by termites in search of additional contacts with ground moisture. If an unexcavated portion under a house is not well ventilated, tubes such as these on the left would succeed. Those on a wall (right) did establish contact.

BASIC SHIELD DESIGN (Cont.)

Deflector Type Shields

The Deflector type of shield shown in **Figure T-2** does not provide an impassable Barrier to the termite. It is used at points which are easily available to inspection, as at the interior wall of a basement recreation room, or on the outside where a brick porch abuts a wall.

In order to build a shelter tube from the ground moisture to the woodwork of a house, the termites will be forced to come out around the shield as indicated at the "point of detection." Then, if the shelter tubes are broken off, the termites in the building will quickly die for want of ground moisture. It should not be neces-

sary to repeat this simple procedure many times before the workers from the colony become discouraged and look elsewhere for a source of food supply.

The Deflector type of shield, plus inspection, gives the same 100% protection that the Barrier type gives. Other varieties of Deflector type shield or compromises between Deflector and Barrier types are indicated in subsequent sketches. The Deflector type should be used only where periodic inspection can easily be made. In most cases this inspection need be made at intervals of only once or twice a year.

KEY PLAN FOR SUGGESTED APPLICATIONS

Figure T-3 shown a plan view of a house. This figure serves as a key to the subsequent drawings in this pamphlet, which show typical details of application of shielding in various locations in a house. The index scheme used is that Section 5-5, for instance, will be found in **Figure T-5**, etc.

It should be understood, of course, that shielding is equally effective for new construction and for the protection of an old house even if subterranean termites have already invaded it. In the latter instance the house will, of course, have to be shored up or jacked up from its foundations in order to insert the shielding between the framework of the house and the foundations. The shielding will cut off from their contact with ground moisture any termites that may be in the house. Without moisture they cannot live. The shield also isolates the nest, in the ground, from the house.

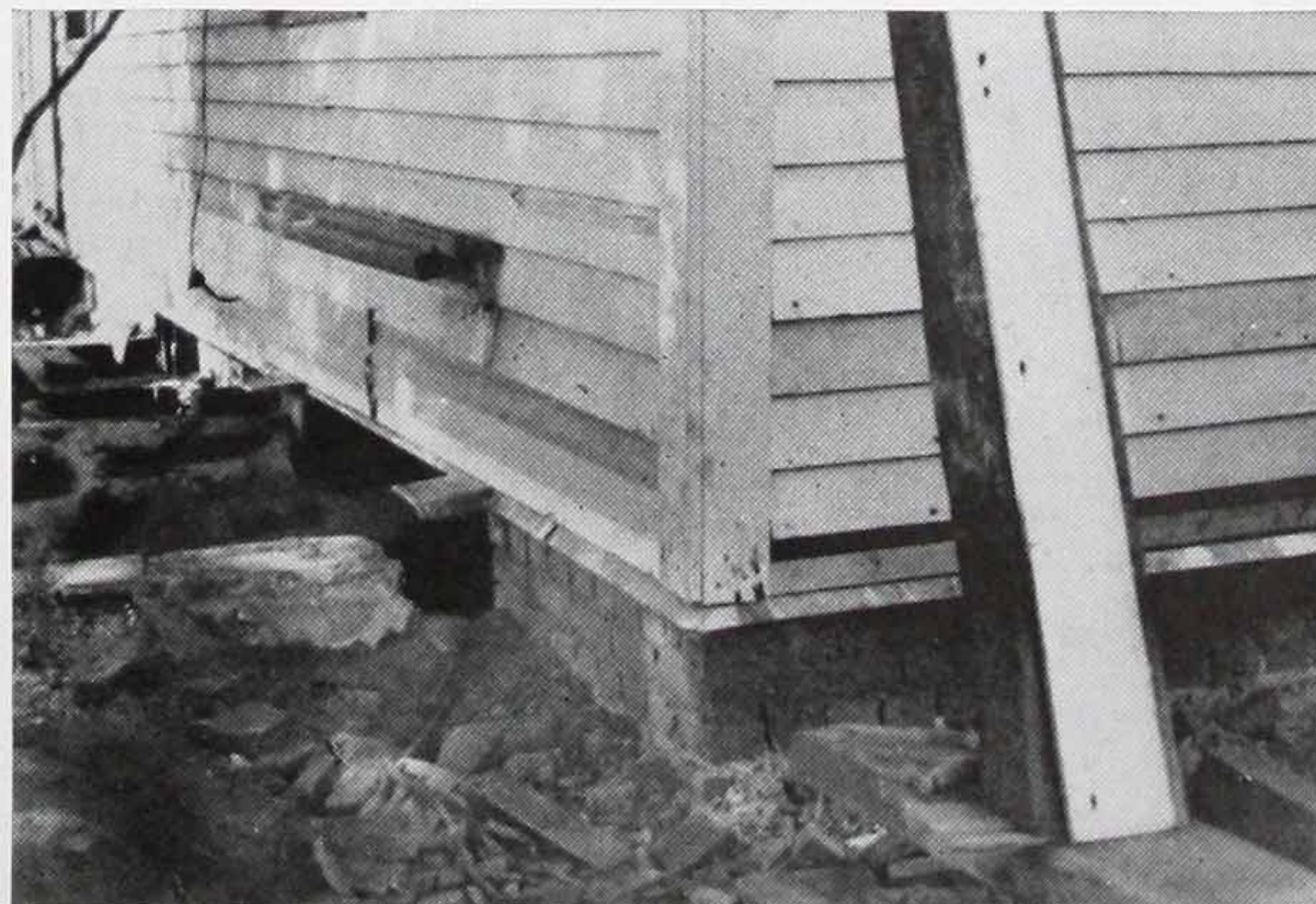
They will undoubtedly attempt to build shelter tubes down to the ground and, if a shallow unexcavated section is left, might possibly succeed in dropping a tube from a joist to the ground. However, if proper ventilation is provided it is not likely that they can succeed. Under moist conditions shelter tubes can be built for some distance unsupported, but when dry this cannot be done for the tubes would have little strength beyond what might be expected of a column of dry sand.

For either old or new construction ventilation should be provided under unexcavated portions of a house. There should be two square feet of opening for each 25 lineal feet of wall. All ventilating openings should be screened with 20-mesh standard weight bronze screens. In new construction old wooden forms used in pouring concrete, and other lumber scrap, should be removed from the immediate vicinity of the house.



Wood Preservatives, Inc.

An excellent example of the proper application of copper termite shielding on the foundations of a new house under construction. Note at right Deflector type where a brick porch is to be built.



Installing copper termite shields in a house that has been attacked by subterranean termites. This view shows part of the shielding in place before the installation was finished and shoring removed.

TYPICAL FOUNDATION WALLS

In **Figure T-4** are shown typical sections through foundation walls when houses are of frame construction, brick veneer, or solid masonry. In the southern part of the United States the shield should clear the ground by from 12 to 18 inches, whereas in northern states probably from 9 to 15 inches is sufficient. The degree of local infestation is another factor to be considered in determining proper clearance.

For some houses there will be objection to the line of shielding showing on the outside of the house. When such is the case this point is, of course, open readily to

inspection and a modification of a true Barrier type of shield can, therefore, be used, with the understanding that there will be inspection at intervals to see that no termite shelter tubes have been built. Shrubby around the house will also tend to conceal the installation.

Attention is drawn to **Detail A** showing how the hole for an anchor bolt through the shield is made termite-proof. Instead of the copper washer as shown, special nuts with grooves may be used. In either case the two should be drawn so tight that there is no opportunity for the termites to come through at this point.

CELLAR WINDOWS AND FIREPLACES

Figure T-5 shows the detail of shielding construction at a cellar window. As the window itself is below the level of the shield, to secure complete protection the window should be a metal one. If it is wood construction, it is of course open to attack and is not protected

by the shield which protects the wood on the house above.

Figure T-6 shows the protection afforded a fireplace by Barrier shields over the foundation wall. The detail shows the fireproof arch, with the ash-dump above the shield and the ash-flue below.

CELLAR HATCHWAYS

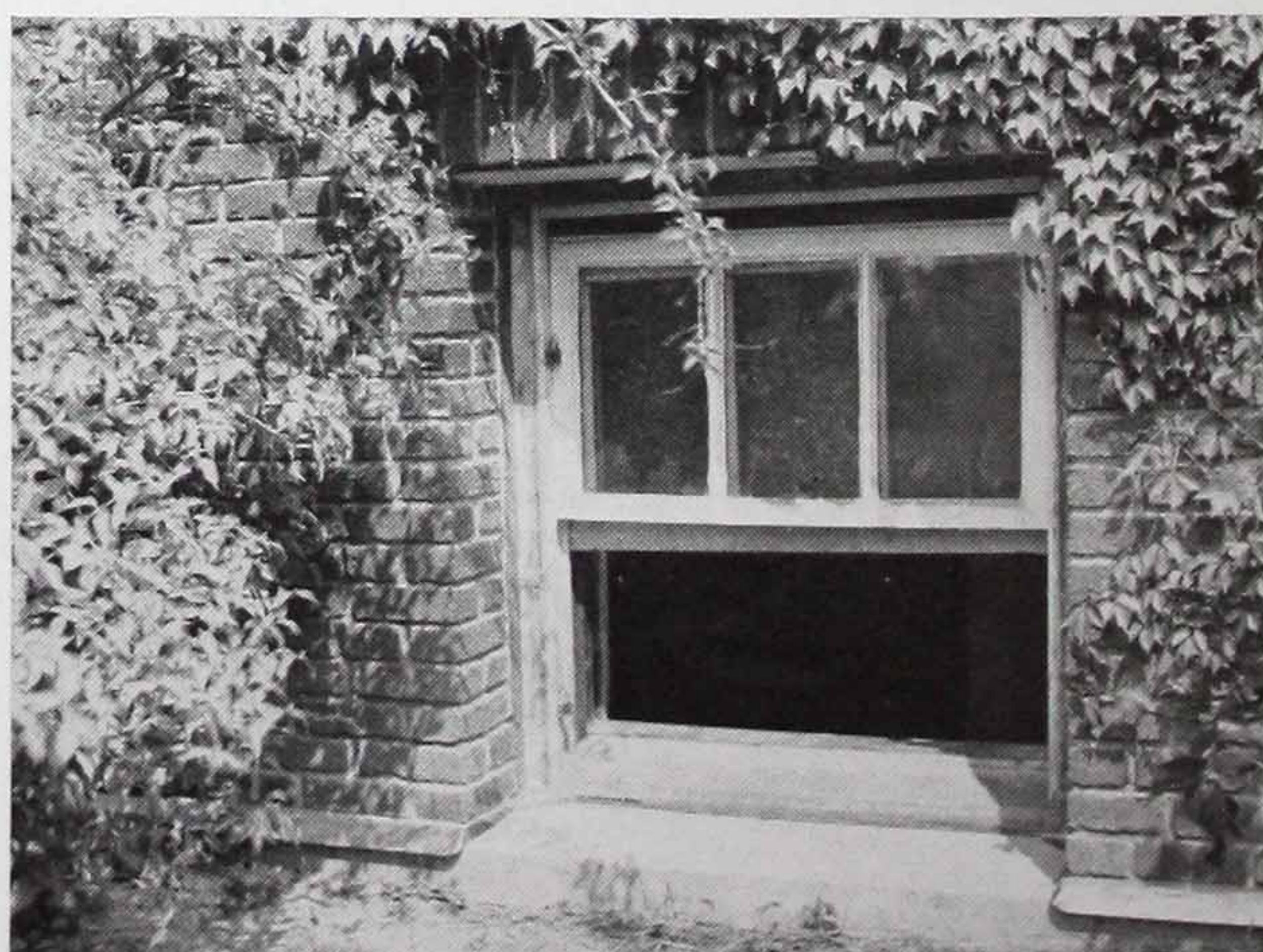
Figure T-7 shows details of a typical cellar hatchway. It will be noted that this construction combines Barrier with Partial Deflector type of shield. For where the shield extends vertically it is conceivable that shelter tubes might be built around it. But here again we have a point easy of inspection where the Deflector type of

shield, plus inspection, gives a building 100% protection.

It will be further noted that the cellar door is shown as of wood construction. This is below the shield and, therefore, not protected. Metal construction for door and frame would be necessary if all opportunity for termite damage is to be eliminated.



Another view of the installation of copper termite shields to protect a house that has been attacked by termites. Note detail at cellar hatchway is a combination of barrier and deflector shields.



View of finished copper termite shield installation at a cellar window which is above ground level—a fine combination of barrier and deflector types of shield that will give full protection.

DOOR SILLS AND PORCHES

Figure T-8 shows, in section, the shielding under a door sill. On the inside the shield is a true Barrier type, while on the outside the shield is a Deflector type, as the porch is assumed to be concrete (or brick) and this is a point easy of inspection. Note that the shield is bent up behind the kick-board to form a water stop. At the upper right is shown a Deflector type shield under a wooden post resting on a concrete or brick porch.

Figure T-9 shows, in section, shielding at the house

wall where the porch is of wood construction. In this instance we must use the Barrier type shield throughout, particularly as the part under the porch is not usually excavated or easy of inspection. Ventilation should be provided—see text explaining **Figure T-3**.

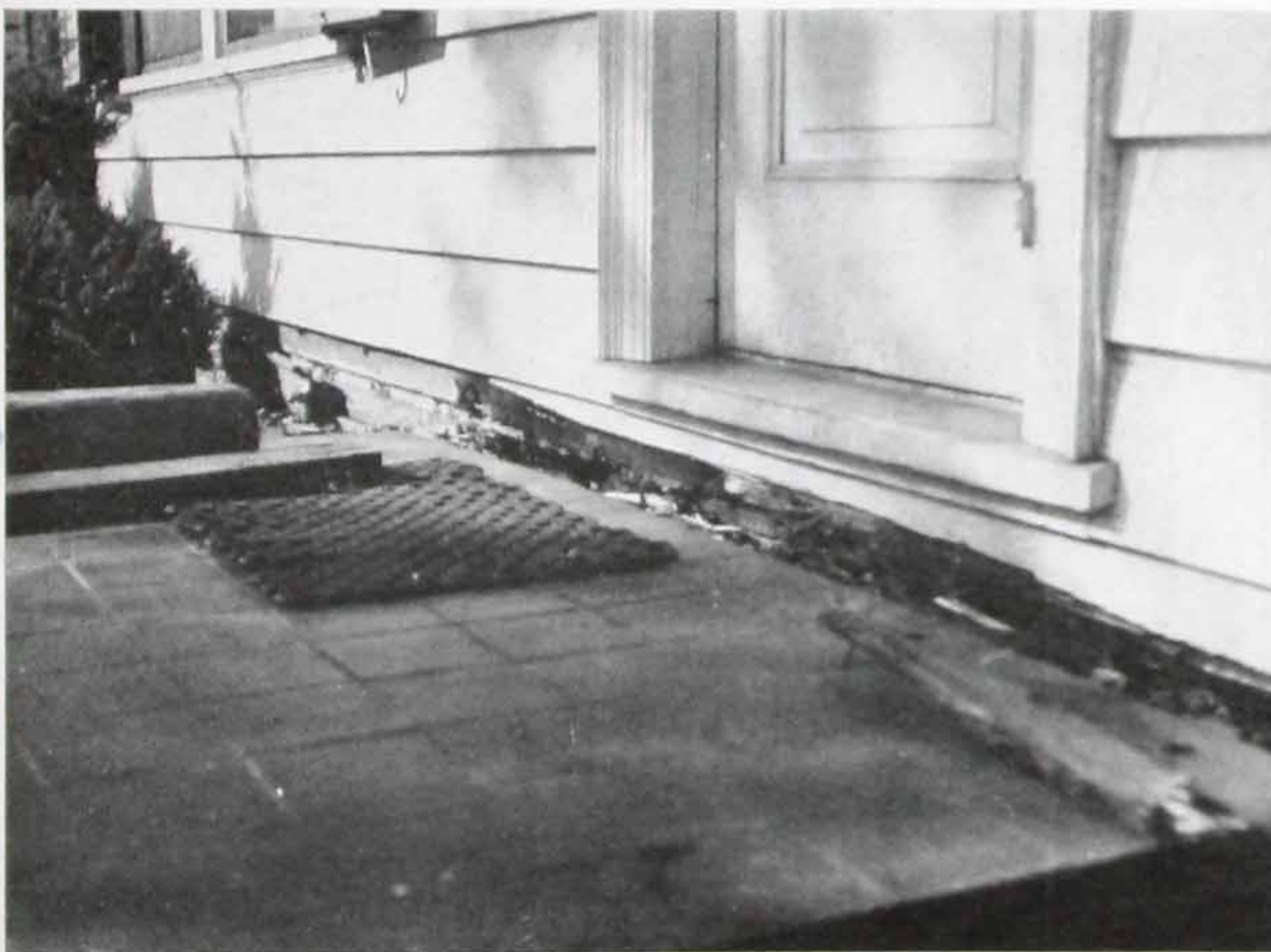
In the upper right hand corner is shown the shield at the outside of the porch. When exposed a Deflector type shield can be used as shown, otherwise a Barrier type should be used.

BEAM POCKETS AND PARTITIONS

Figure T-10 shows the handling of shield details at a cellar beam pocket. The shield, of course, must be cut, fit and soldered as required by dimensions of the beam, thickness of wall, etc.

Figure T-11 shows details of shielding of cellar partitions and other miscellaneous items. The types of shielding shown in details A and B are, of course, of the Deflector type. They may be used between the cellar

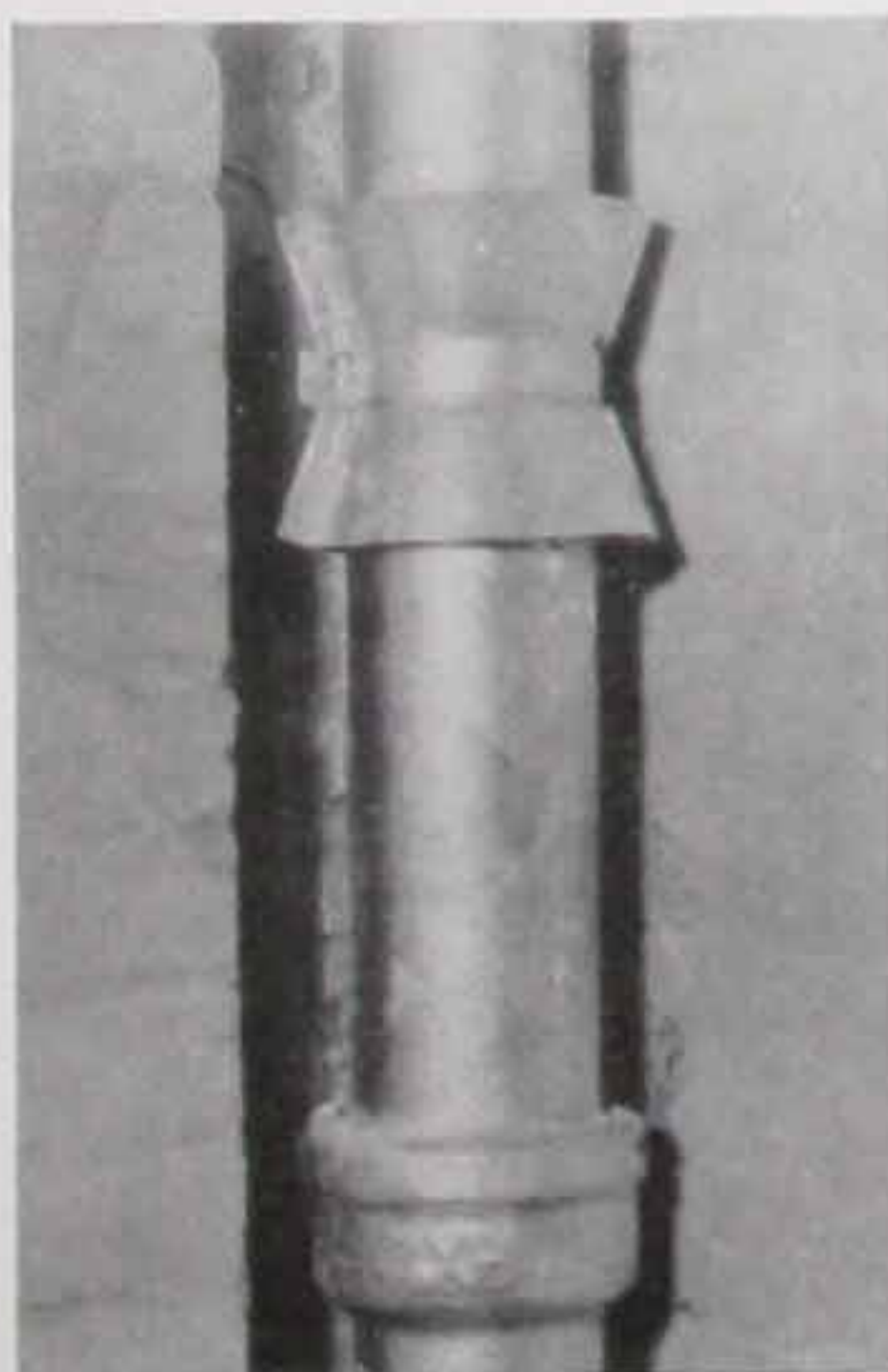
floor and a cellar partition, or between the partition and the side wall of the cellar. Inspection should be made from time to time to check that no shelter tubes have been built around the shield. Detail C shows a Barrier type shield protection for a cellar post. Note concrete footing—do not have posts embedded in cellar floor in contact with earth. Detail D is self-explanatory. Note extra width of shield required.



Exposure of termite damage under a door sill, before renewal of damaged wood and installation of copper shielding has been started. This is a favorite point of termite attack upon a building.



Copper shields over concrete base provide protection against further attack by termites to this porch and the steps. Clearance to ground is less than standard and inspection will be required.



Left: Copper termite shield on soil pipe in chase. Top funnel is filled with plastic coal tar pitch. Main shield (not shown) protects the chase from attack.



Right: In a large concrete building these basement files were vulnerable to termite attack. The problem was solved by copper shields over brick piers.

MEANS OF IDENTIFYING TERMITES

Termites are sometimes confused with other wood-boring insects. There are, however, certain distinguishing features, which, if known, make confusion impossible. Termites are the only common wood borers which make communal galleries in which numbers of insects can move freely. Their nests are always in the ground and not in the wood itself which is their food supply.

The features which distinguish termites from other wood boring insects are set out in the following table which is reproduced through the courtesy of the Commonwealth of Australia where the Council for Science and Industrial Research Division of Forest Products has for many years been devising ways and means of ridding that country of these pests:

MEANS OF DISTINGUISHING TERMITE DAMAGE FROM THAT OF OTHER WOOD BORERS

Subterranean Termites	Carpenter Ants	Lyctus or Powder-Post Beetles	Anobium or Furniture Beetles	Xestobium or Death Watch Beetles
Attack kinds of lumber commonly used in building construction. Heartwood of cypress, red cedar and redwood relatively resistant.	Nest in many kinds of wood.	Attack sapwood of hardwoods (hickory, ash, oak, etc.)	Attack seasoned hard and soft woods.	Attack seasoned hardwood only (oak, chestnut, etc.)
Enter wood through some direct or indirect contact with the ground.	Enter wood usually through a moist or rotten area.	Eggs deposited in cracks or pores.	Eggs deposited in cracks or pores.	Eggs deposited in pores or cracks.
Make irregular galleries, usually consuming only softer layers.	Make irregular galleries.	Make tunnels about $\frac{1}{16}$ " in diameter.	Make tunnels about $\frac{1}{16}$ " in diameter.	Make tunnels about $\frac{1}{8}$ " in diameter.
Galleries contain no fine dust but may contain masses of earthy frass.	Galleries open or with fine particles of wood.	Tunnels packed tightly with fine powder.	Tunnels packed tightly with fine powder.	Tunnels packed tightly with fine powder.
No external holes.	No external holes.	Emergence holes about $\frac{1}{16}$ " in diameter.	Emergence holes about $\frac{1}{16}$ " in diameter.	Emergence holes about $\frac{1}{8}$ " in diameter.
Living termites found in galleries or the characteristic spots of frass on the sides of the galleries.	Large black ants in nest or clean galleries with no frass spots. Galleries much smoother than termite galleries.	Inconspicuous grubs present in tunnels. Abandoned tunnels filled with powder.	Same as Lyctus.	Same as Lyctus. Usually attacks only old houses.

ACKNOWLEDGEMENT

The Copper & Brass Research Association wishes to acknowledge with thanks the cooperation it has received in the preparation of the material for this book from the United States Bureau of Entomology, Washington, D. C. and the Bureaus of Entomology of the States of Connecticut and Louisiana. All photographs, except where otherwise credited, have been furnished by the Bureau of Entomology of the Connecticut Agricultural Experimental Station.

REFERENCES

FEDERAL SPECIFICATIONS FOR PREVENTING AND REMEDYING TERMITE DAMAGE

The Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture has prepared sets of specifications for preventing and for remedying termite damage. These are in mimeographed form and may be obtained from the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, on request.

PUBLICATIONS RELATING TO TERMITES

For the information of those who desire to have more complete information on termites and their control than is found in government publications, the following literature can be consulted:

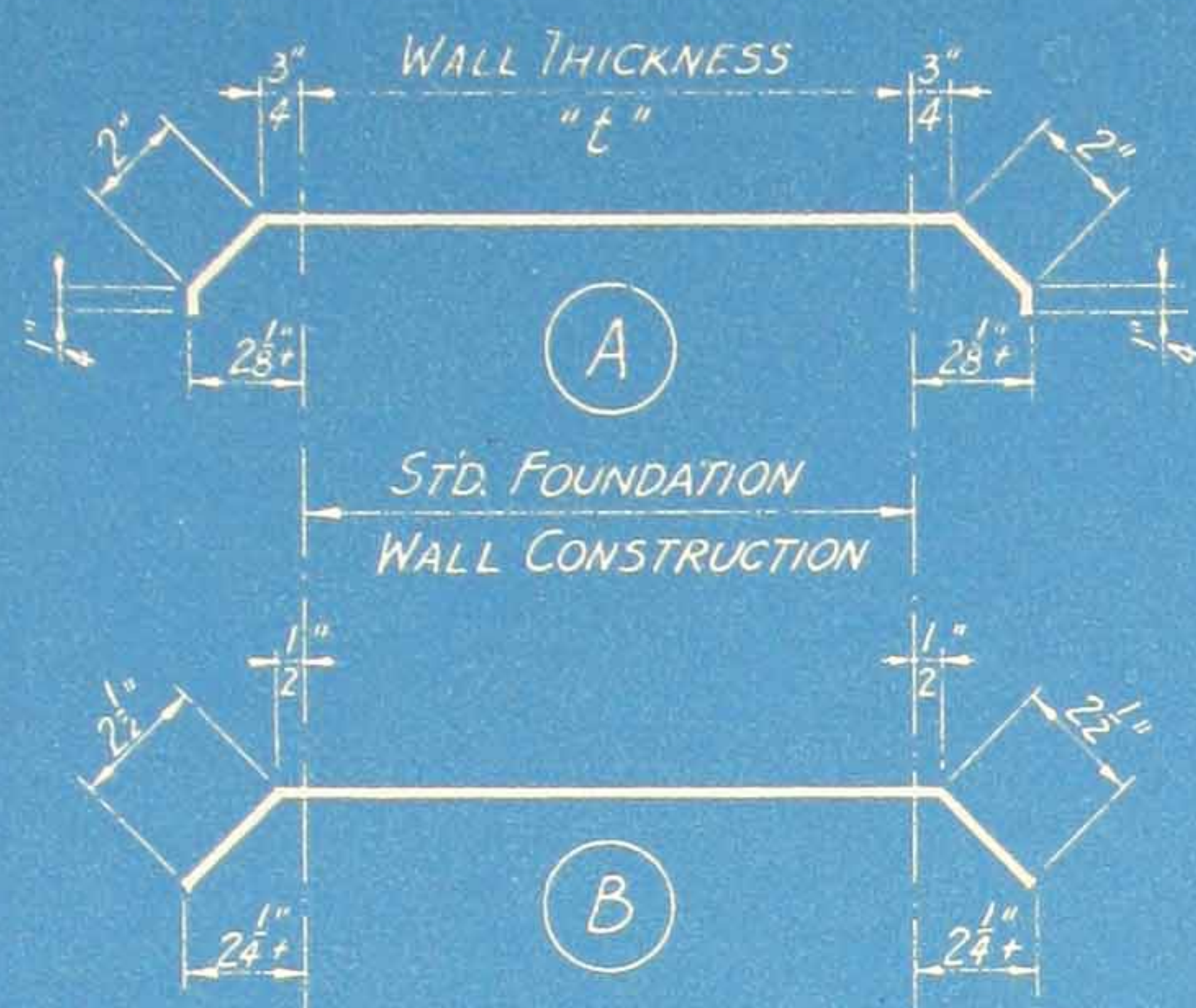
1920. Banks, N., and Snyder, T. E.
A revision of the nearctic termites with notes on biology and geographic distribution. Smithsonian Inst., U. S. Nat. Mus. Bull. 108. 228 pp., 53 pls., 70 text, figs.
1926. Snyder, T. E.
The biology of the termite castes.
Quar. Rev. Biol., Vol. 1 (4), pp. 522-552, 15 figs.
1934. Kofoed, C. A. (ed.), and others.
Termites and termite control. 754 pp. 182 figs. University of California Press, Berkeley, Calif.
1935. Snyder, T. E.
Our enemy, the termite.
196 pp., 36 figs., 10 pls. Comstock Publishing Co., Ithaca, N. Y.

Agricultural Experiment Stations in various states are also following the subject of termites and their control. They will be glad to cooperate with you in giving further advice relating to identification of the insects and their damage in your state or locality.

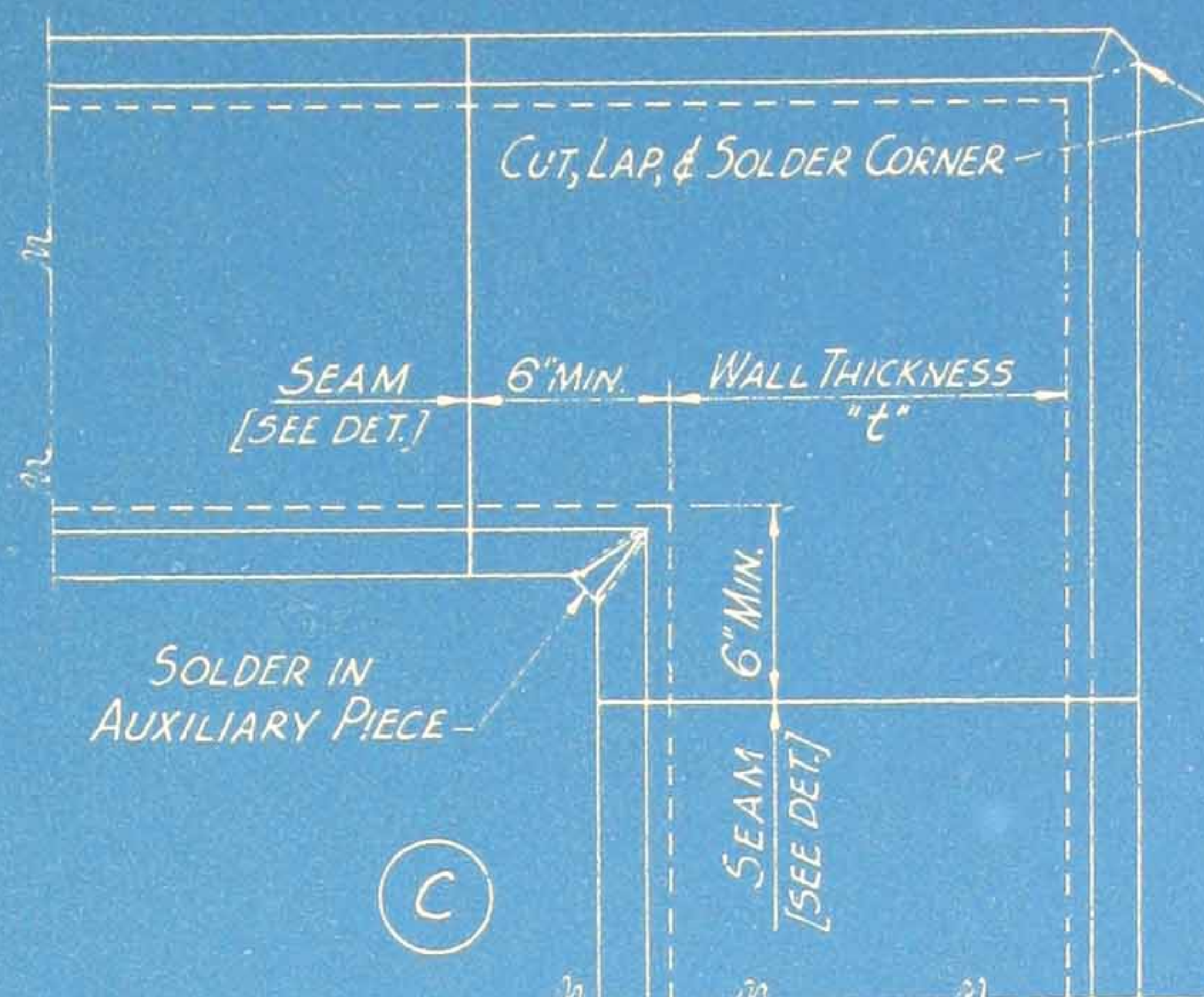
TIME HAS PROVED
THE SERVICE OF
COPPER AND ITS ALLOYS



*Extra copies of the blueprints in the pocket opposite, with
accompanying explanatory data can be obtained on request.*



STD. BARRIER SHIELDS
[WIDTH OF SHEET = $t + 6$ "]

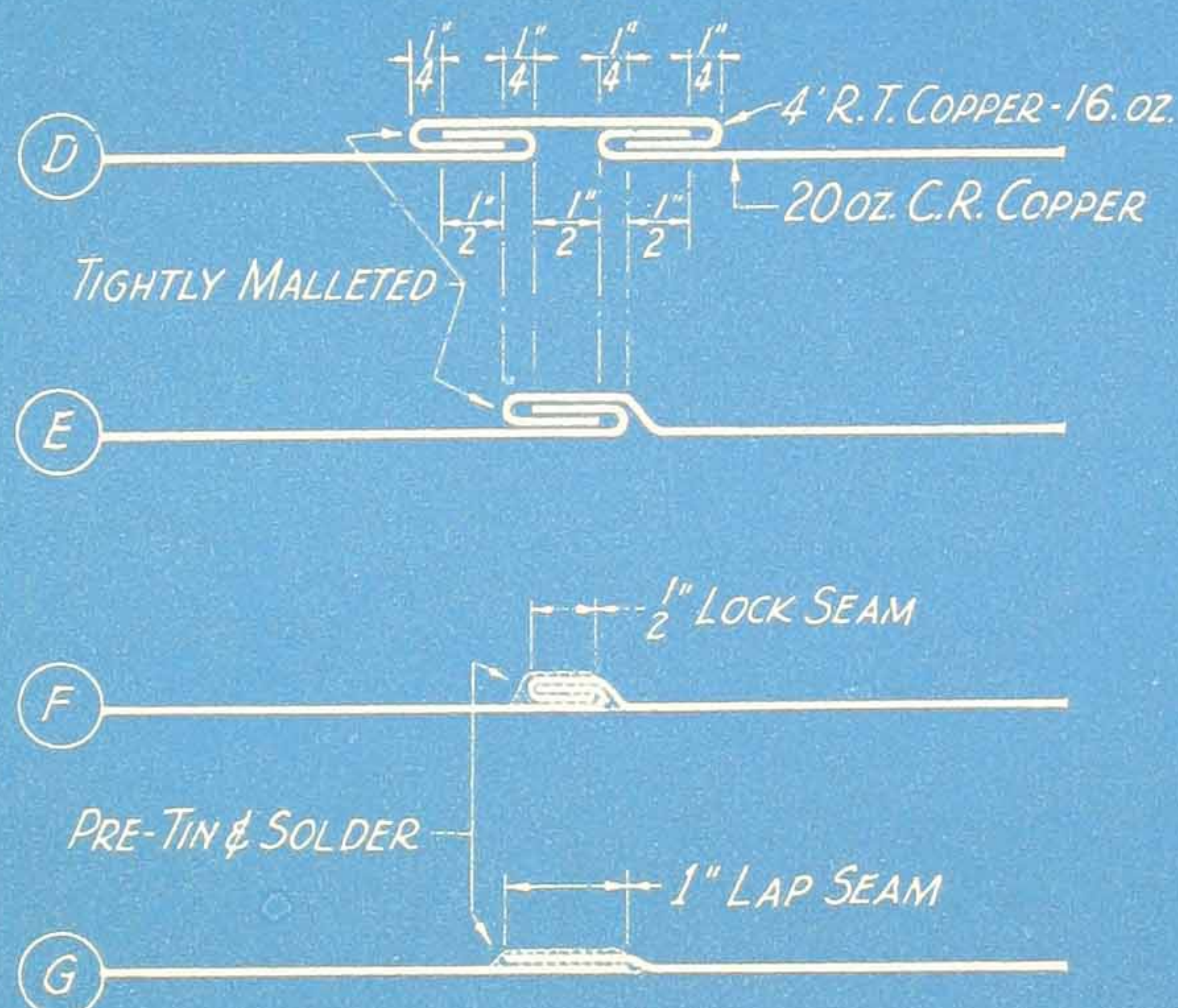


PLAN OF CORNER SHEET
[MIN. WIDTH TO ORDER = $t + 12$ "]

ESTIMATING TABLE
[FOR STRAIGHT RUNS]

WALL THICKNESS	WIDTH OF SHEETS	ORDER*
8"	14"	14"x96" C.R. SHEET
10"	16"	16"x96" DO.
12"	18"	18"x96" DO.
16"	22"	22"x96" DO.

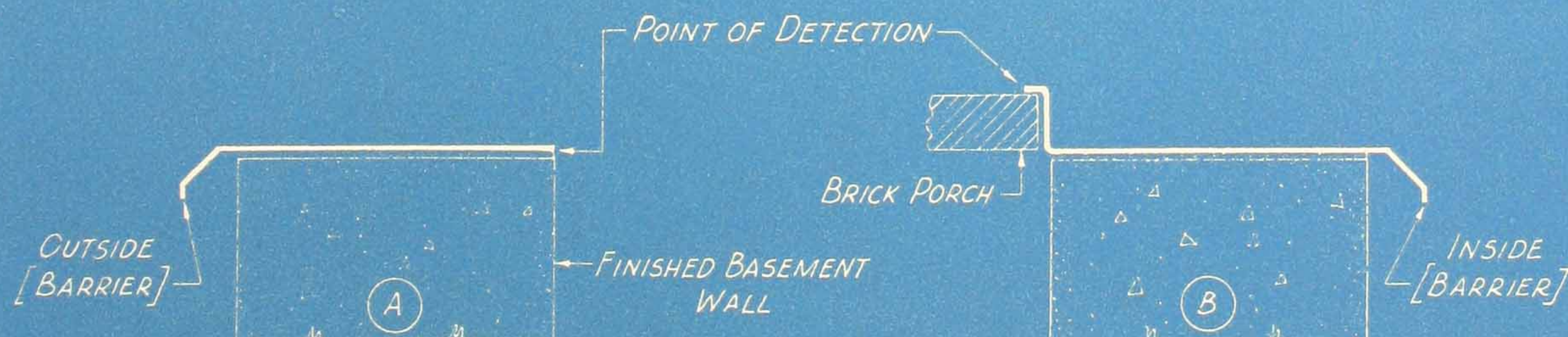
* EXCLUSIVE OF CORNERS AND SPECIALS



CROSS SEAMS

TERMITE BARRIER SHIELDS

FIG.T1



TERMITE DEFLECTOR SHIELDS

FIG.T2

Q

Q

FIG. 11

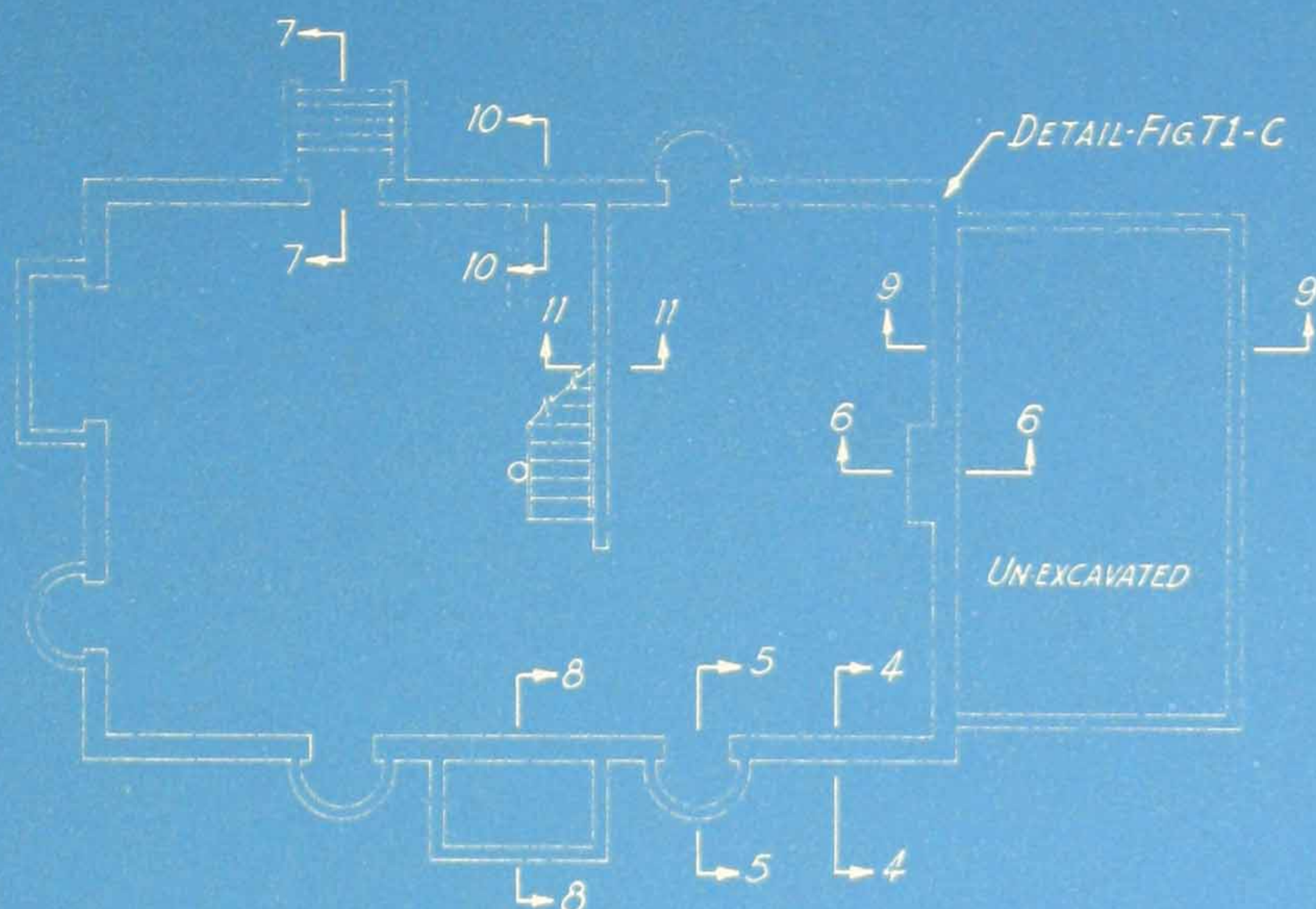
TERMINAL BARRIER SHIELD

FIG. 12

TERMINAL DEFLECTOR SHIELD

100-1000

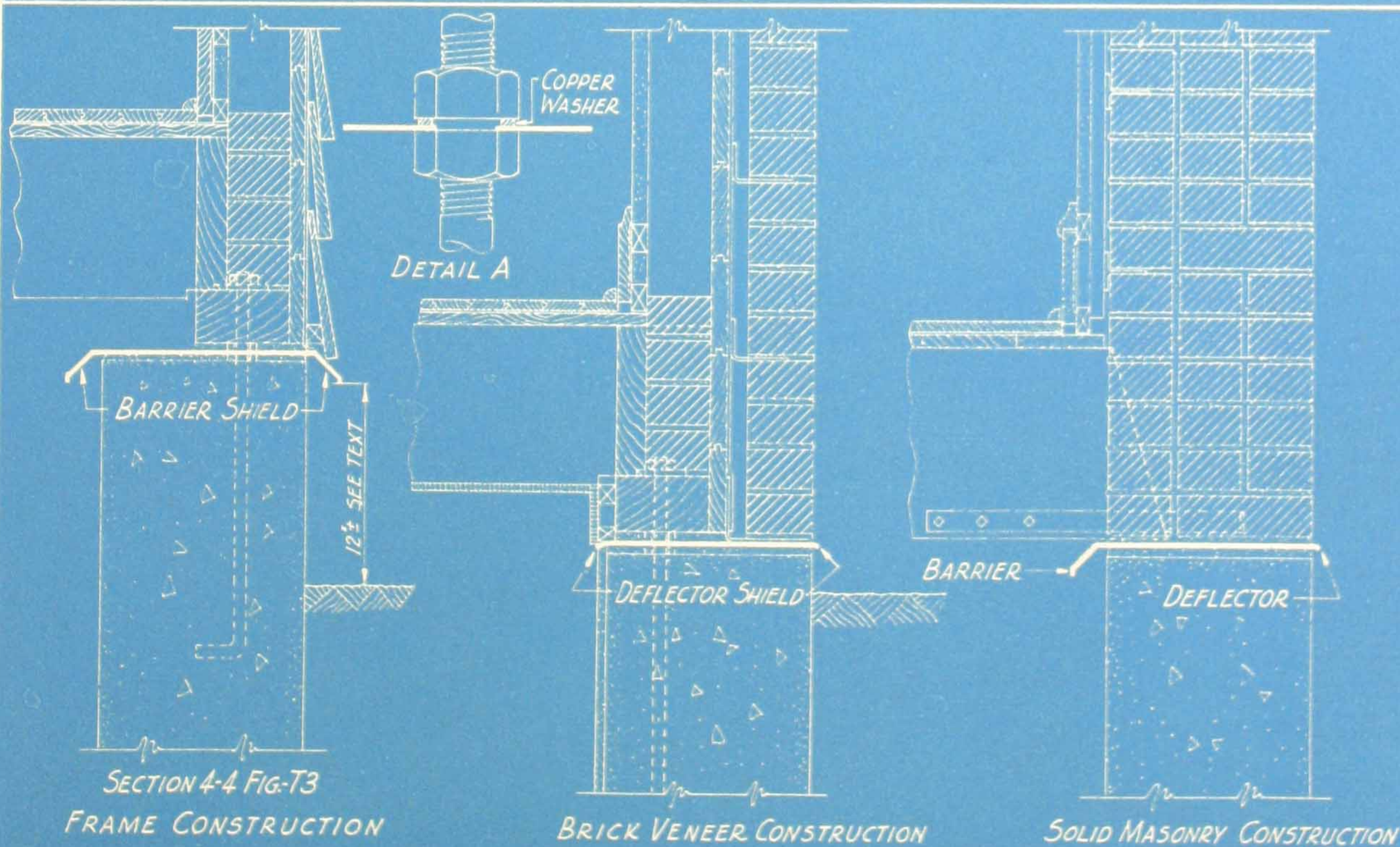
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PLAN OF TYPICAL BASEMENT FOR A SMALL HOUSE
FOR SECTION 4-4 SEE FIG.T4 [ETC.]

KEY PLAN-APPLICATION OF COPPER TERMITE SHIELDS

FIG.T3



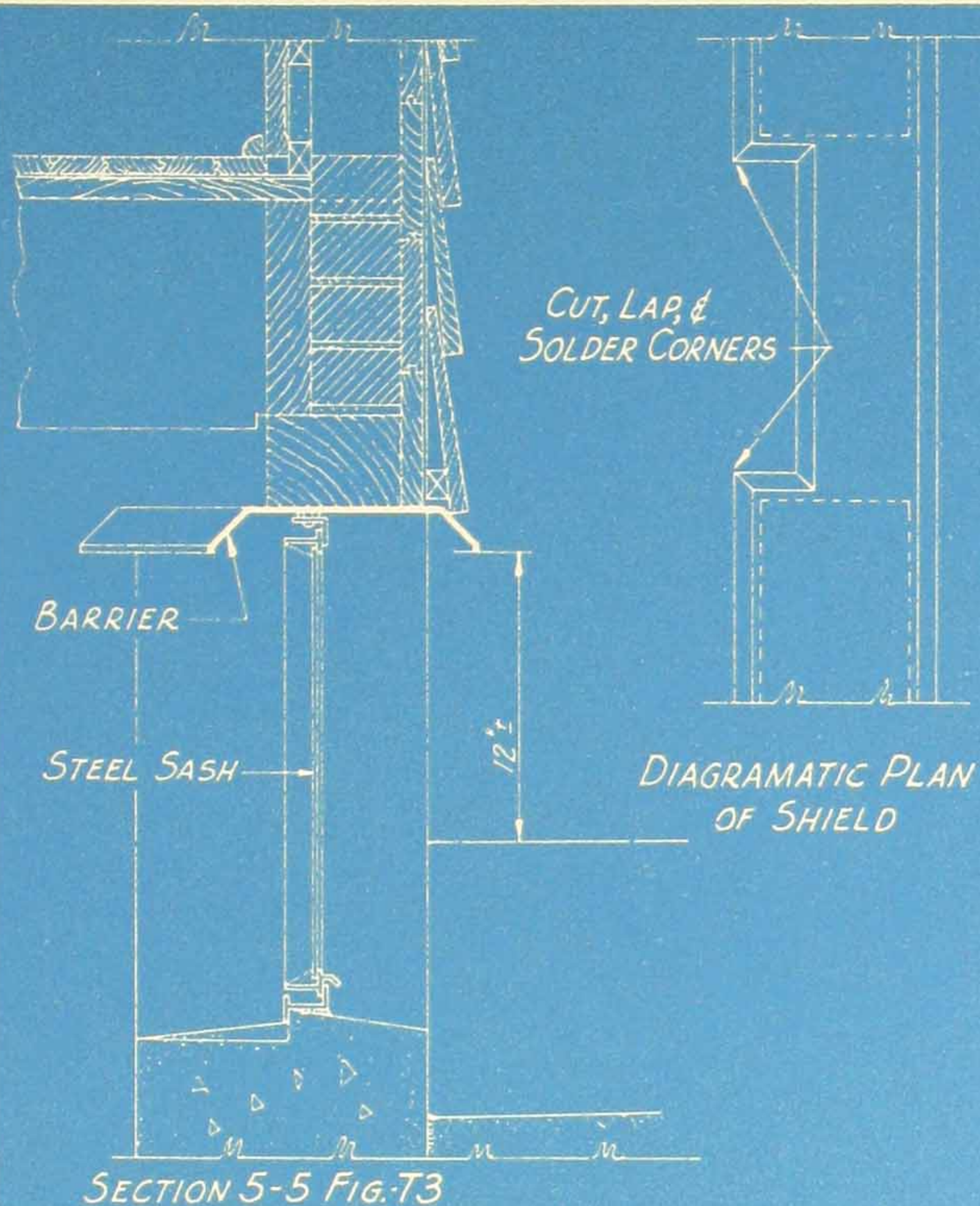
TYPICAL FOUNDATION WALLS

FIG.T4

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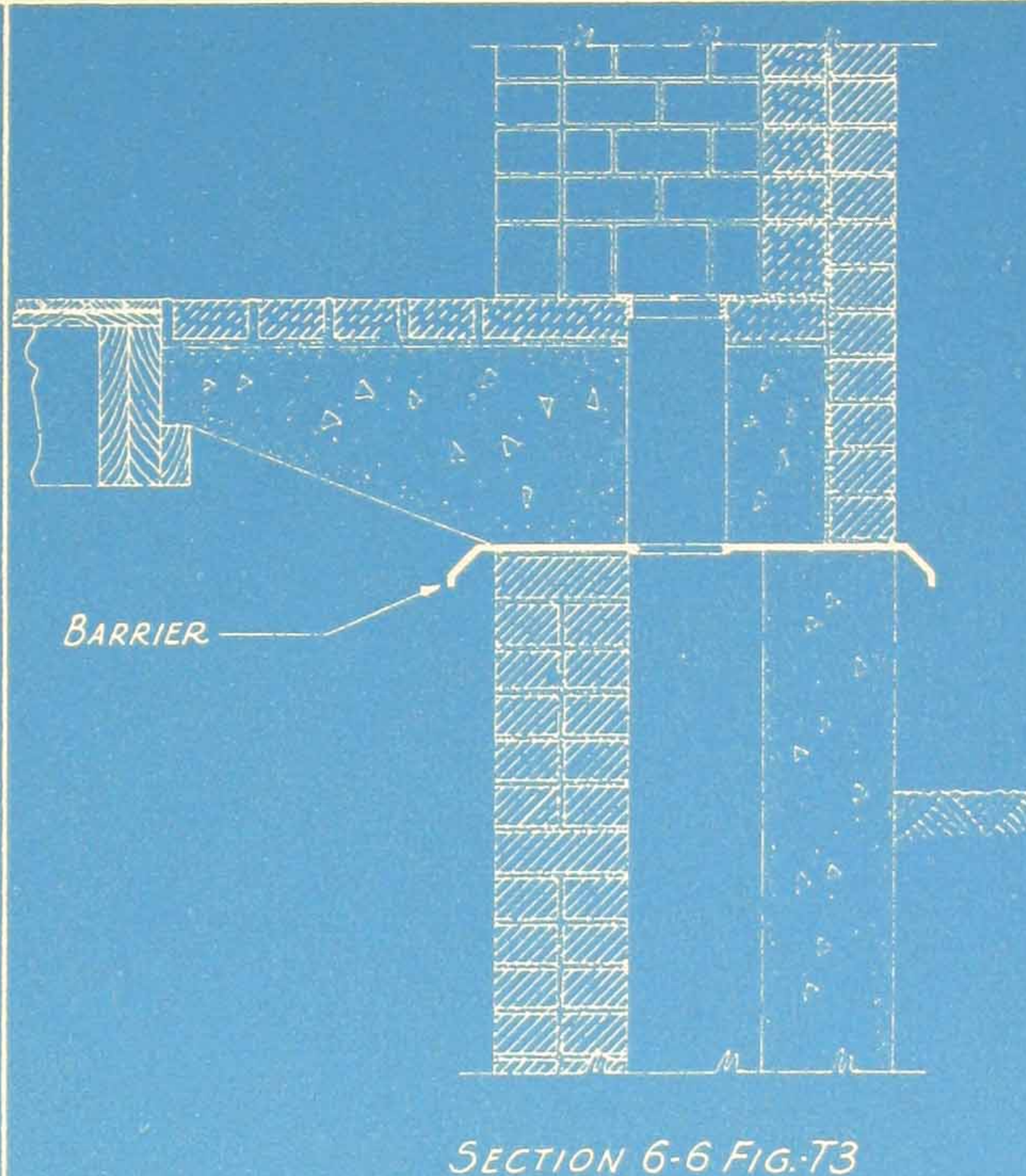


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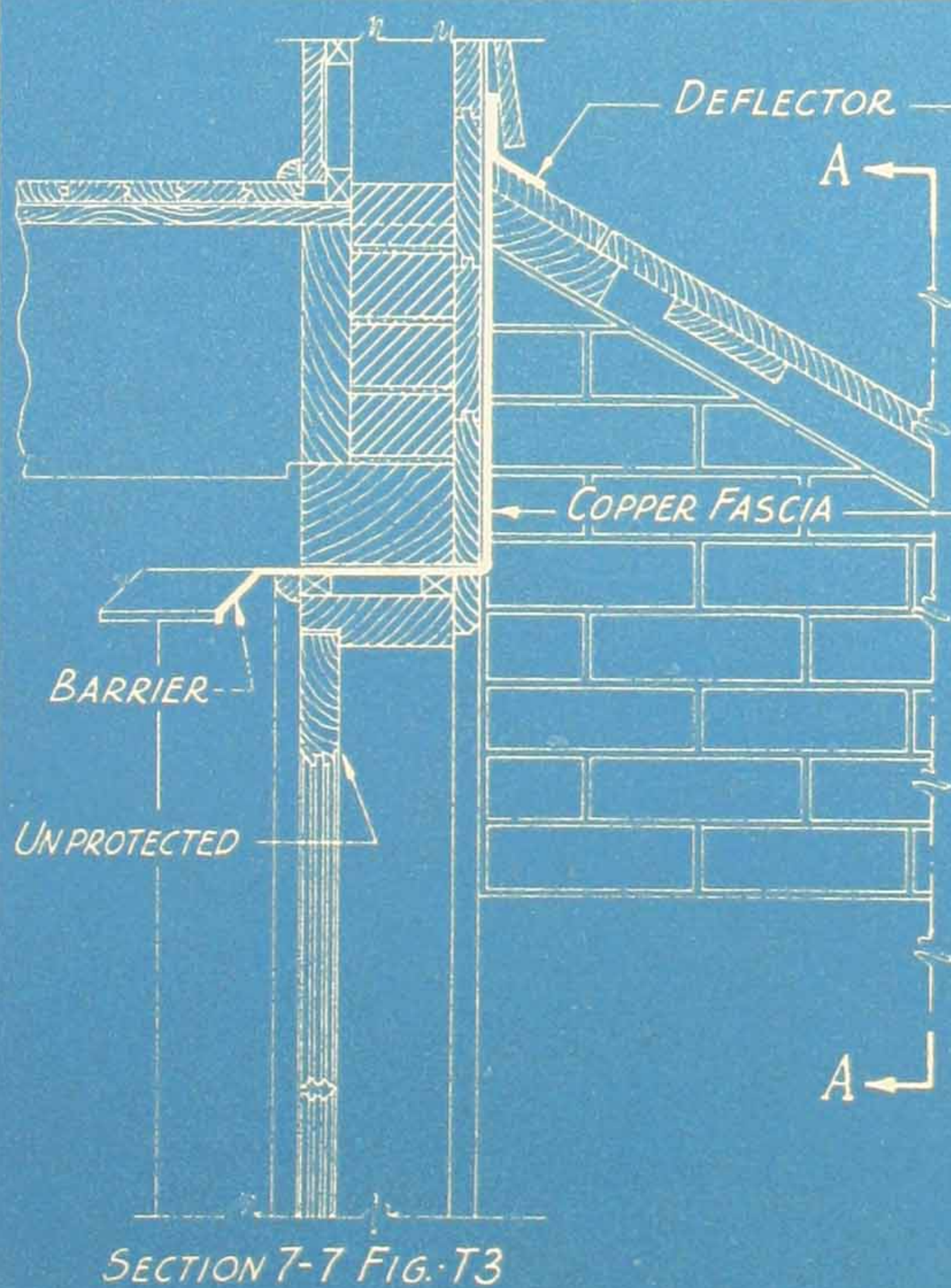
TYPICAL CELLAR WINDOW

FIG. T5



FIREPLACE

FIG. T6



CELLAR HATCHWAY

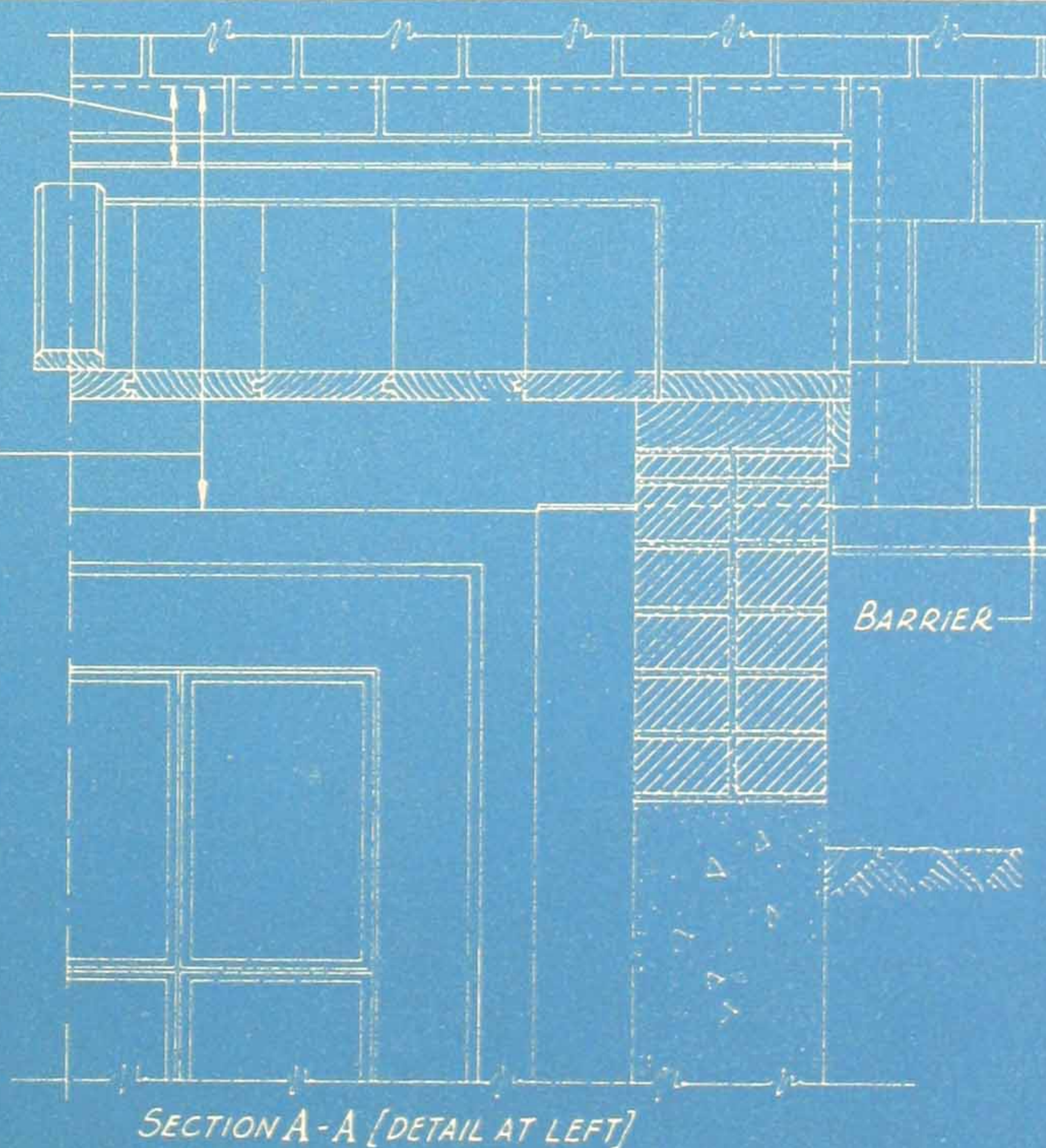


FIG. T7

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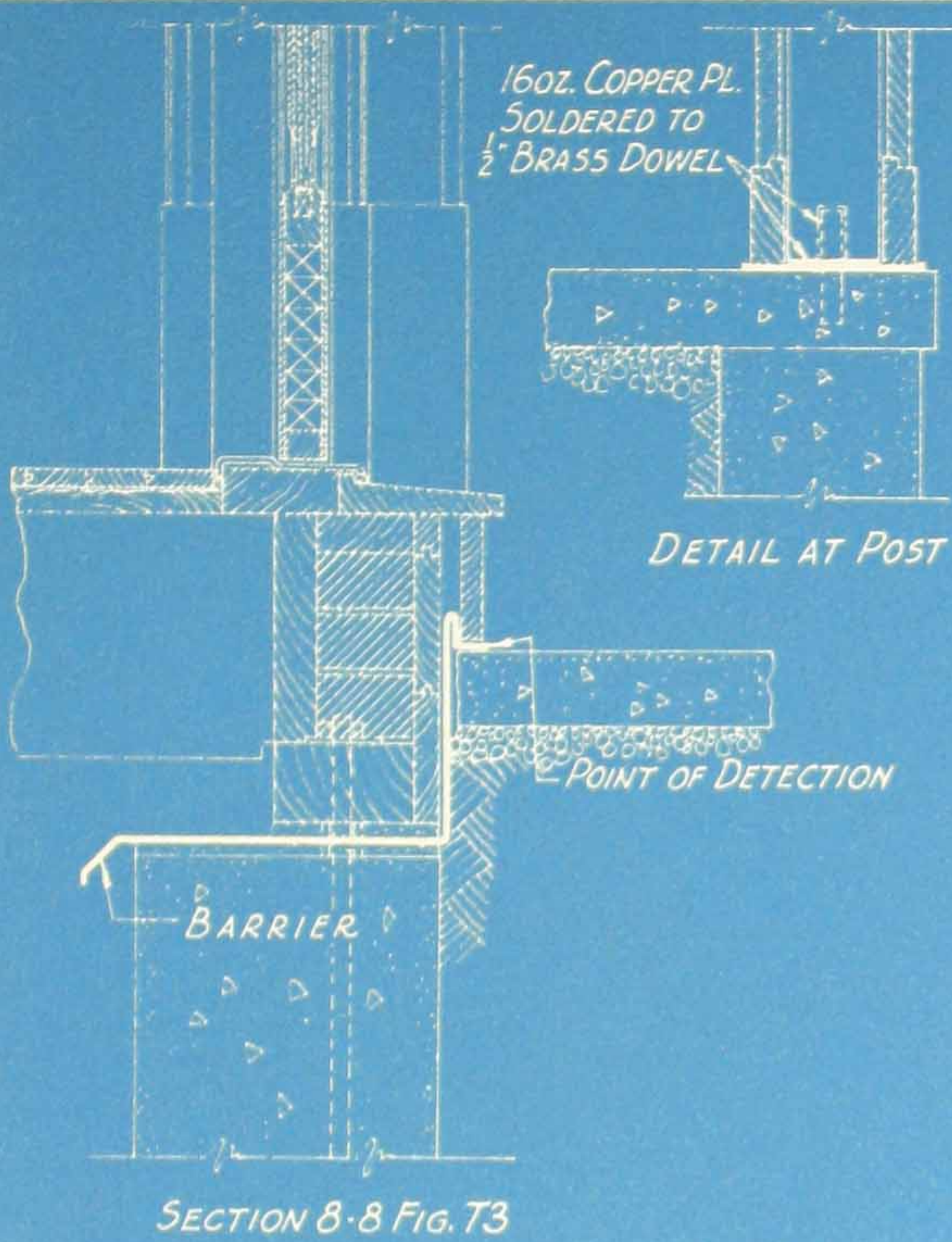
FIGURE 1. Plot of $\log k$ versus $1/T$ for the reaction of $\text{C}_2\text{H}_5\text{I}$ with $\text{C}_2\text{H}_5\text{MgBr}$ in benzene at various temperatures.



FIGURE 2. Plot of $\log k$ versus $1/T$ for the reaction of $\text{C}_2\text{H}_5\text{I}$ with $\text{C}_2\text{H}_5\text{MgBr}$ in benzene at various temperatures.

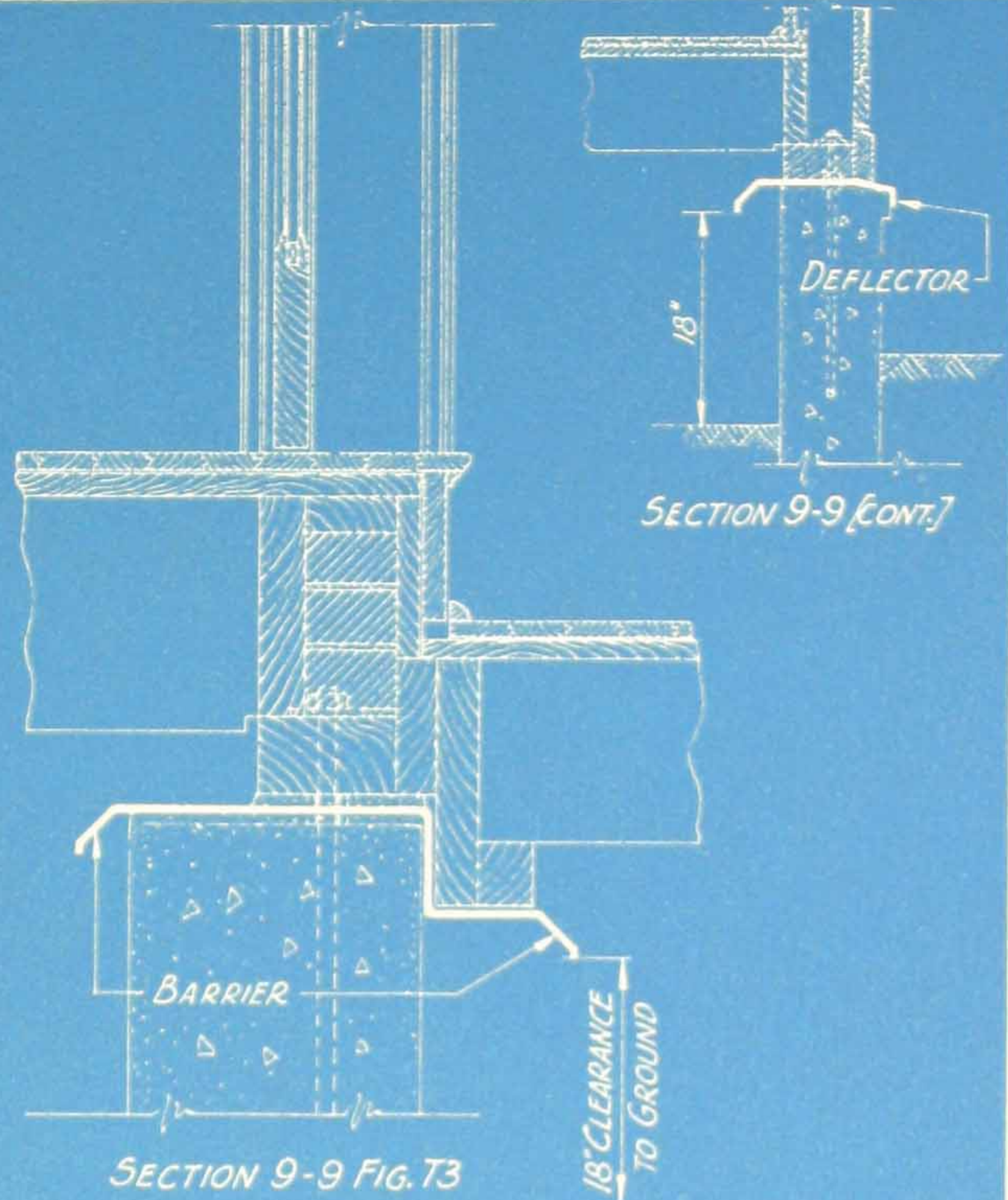


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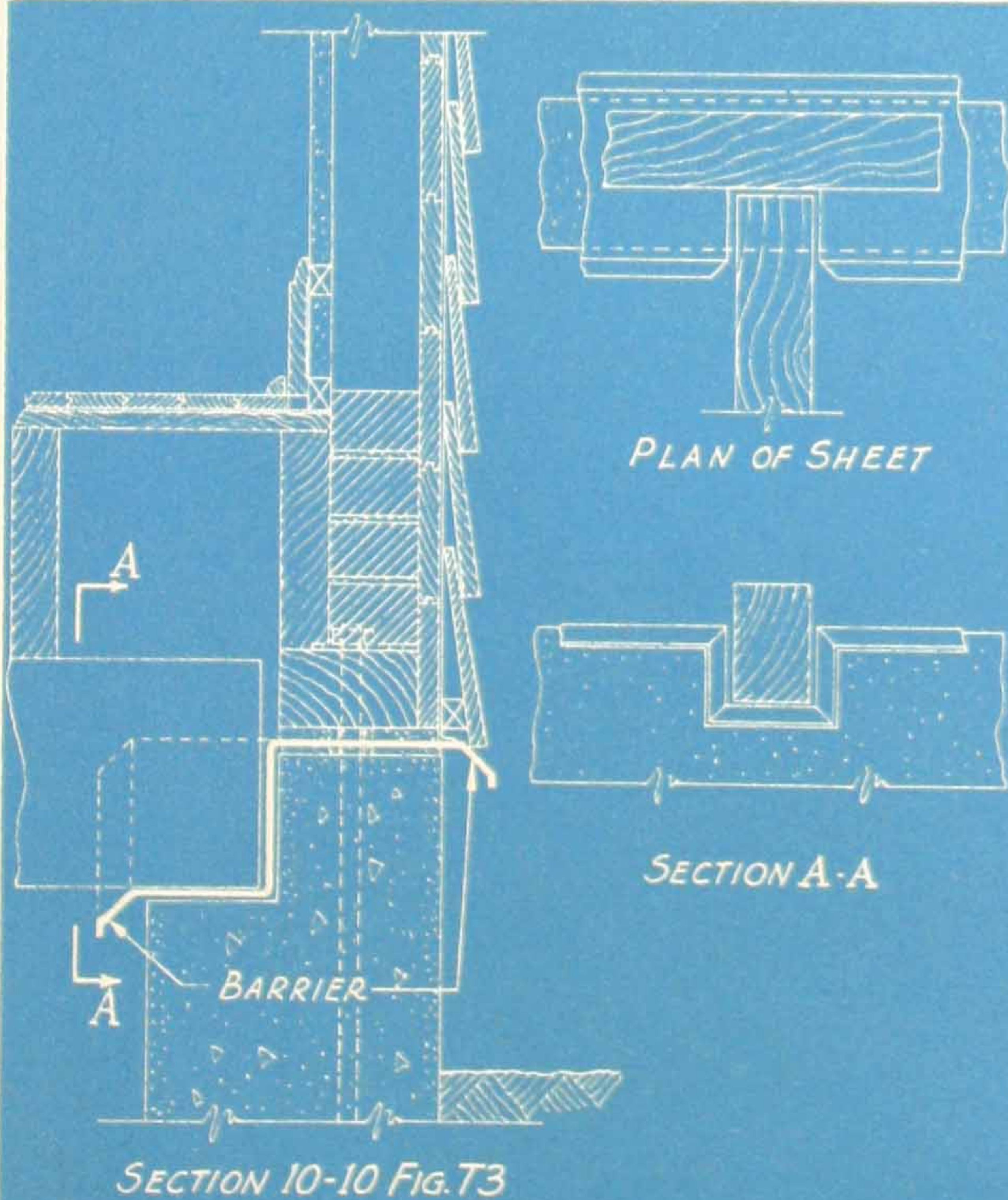
DOOR SILL

FIG. T8



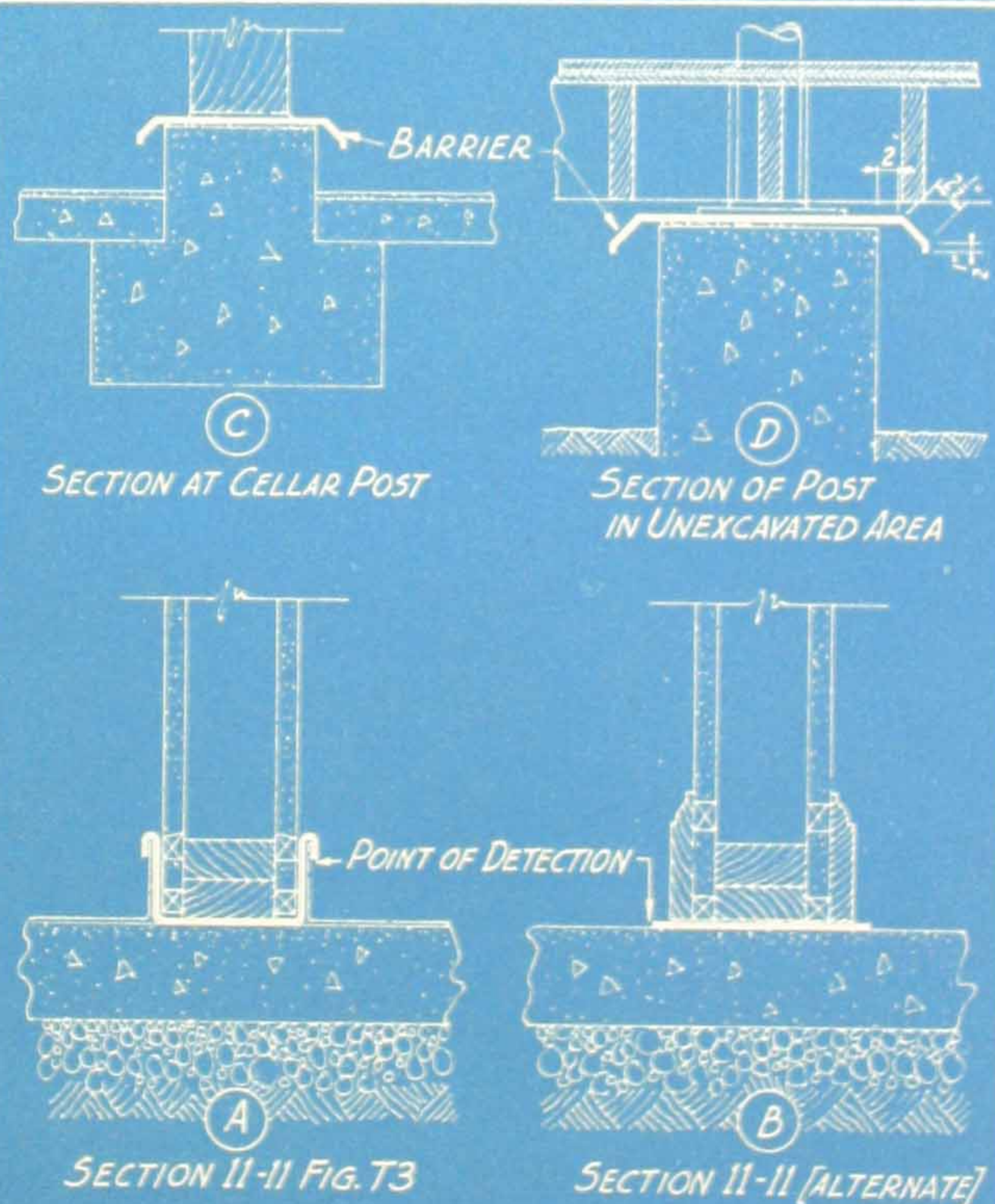
PORCHES

FIG. T9



CELLAR BEAM POCKETS

FIG. T10



PARTITION & MISCEL. DETAILS

FIG. T11

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<p>FIG. 1 Normal control group</p>	<p>FIG. 2 Normal control group</p>	<p>FIG. 3 Normal control group</p>	<p>FIG. 4 Normal control group</p>
<p>FIG. 5 Normal control group</p>	<p>FIG. 6 Normal control group</p>	<p>FIG. 7 Normal control group</p>	<p>FIG. 8 Normal control group</p>
<p>FIG. 9 Normal control group</p>	<p>FIG. 10 Normal control group</p>	<p>FIG. 11 Normal control group</p>	<p>FIG. 12 Normal control group</p>

